

MEMORANDUM

TO: Ms Nicole Le Boeuf
Fishery Biologist, NMFS

FROM: Jay Sweeney, V.M.D.

DATE: September 6, 2002

SUBJ: Report to NMFS from member, Indirect Effects Expert Panel

Thank you for allowing me this opportunity to serve in the capacity as panel member assessing Indirect Effects on dolphins of the purse seine tuna fishery. I have particularly enjoyed the dialogue that was abundant from a very interesting cross section of interested experts. I hope that the discussion below will prove helpful in your quest for direction in this very difficult regulatory matter.

I. Introduction

We, the panel members, were asked to consider available data and statistical modeling information on two stocks of ETP dolphins, the northeastern offshore spotted dolphins and eastern spinner dolphins (the also threatened coastal spotted dolphin was not considered in this exercise), both populations threatened and apparently not undergoing expected rates of recovery. In comparison to the model (s) for population growth in these animals, there are roughly 11,000 individuals respectively from each population that are statistically unaccounted for, a number that represents approximately 2% of these populations and apparently the difference between recovery and the currently evident absence of such (also amounts to about 2 animals possibly lost to indirect causes for each of the two species, for each and every set made). Are these 'missing' animals the result of some ecosystem or demographic factor, or are there causes related to the purse seine fishery activity that can be identified as accounting for, or possibly accounting for, additional unreported mortality at the above noted magnitude?

Specifically addressing the possibility that there are indirect actions relating to this fishing methodology, assessments were facilitated through the course of this panel exercise, examining 1) biomedical data generated from the 2001 NMFS CHESS field study; 2) information available in the published literature, as well as NMFS and IATTC technical reports, and 3) open discussions amongst the accumulated experts. In considering the above reference resources, there remains a very significant absence of sufficient data and direct sighting information to draw clear empirical conclusions as to the relevance to those possible causes (identified and discussed below) that comprise possible indirect mortality events. As such, panel members were asked to draw inferences from the above reference materials, AS WELL AS from subjective interpretations based on professional judgment and experience with related fields and animals.

As the question posed to the Indirect Effects Panel focused on the relative impacts of stress in animals involved in the capture operations, on data from tissue specimens collected from both dead and living animals in the fishery area, on the possible occurrence of cow-calf separations, on possible tissue and/or organ dysfunction resulting from the operations and other physiologic or medical associations that would risk recovery of these populations, I was able to draw from my experience in dealing with health care issues on both captive and wild stocks of cetaceans of various species. Health care management includes, in this case, the assessment of both clinical pathologic data (hematology, parasitology, pathology, etc.), as well as behavioral and physiologic information dealing with the likes of cow-calf bonding behavior, reproduction cycles including nursing and weaning behavior, calf dependency and in interactions that relate to calf morbidity and mortality. In this discipline, our experience is, by far, with the Bottlenose dolphin, Tursiops truncatus. Some have warned that inferences drawn from experience with Tursiops, in situations dealing with stress responses and reproduction physiology and behavior, are unlikely to shed much relevance to similar situations in spinner and spotted dolphins. Tursiops and Stenella, they say, are just too different in their physiology, behavior and clinical pathology. I would maintain, however, that this is not so. In comparing behavior, reproductive events, even clinical responses to stressor events, our experience shows that, where we have had the opportunity of working with pelagic species, they are very consistent with Tursiops, with the caveat that the pelagic species, in general, are considered ‘more sensitive’, ‘higher strung’, ‘more nervous’, ‘higher metabolic rate’, ‘faster’ than their larger cousins. In context to this discussion, for example, a Stenella would be expected to react to a stressor event perhaps to a greater degree than a Tursiops; however, the physiology, and extreme expression, of the reaction that is manifest is the same in both groups of animals. We make this inference based upon our work with species such as Commerson’s dolphins, Cephalorhynchus commersonii, a pelagic species, where we have a relatively extensive history of health care management. Similarly, reproductive physiology and behavior has been observed in Commerson’s dolphins and is compatible, albeit compressed in time frame (as is likely the case with Stenella as well) as compared to Tursiops. With this in mind, I will freely refer to our substantial base of experience with Tursiops in assessing the possible significance of existing data, modeling information, and reference materials on the likelihood of an event being causal to the mortality possibility as discussed above.

II. Mechanisms for possible indirect effects on dolphins associated with the purse seine operations.

- A. Stress- As a cause of indirect mortality in, or associated with, the encirclement of dolphins within the purse seine net, my opinion is that stress, in-of-itself, does not represent a primary factor.
 1. Stress hormones, catecholamines, electrolytes, as detected in the CHESSE study, are not, considering the circumstances, outside of expected values.
 2. Dolphin behavior, as observed and reported, either inside the encirclement or outside of it (before, during or after the net set) does not exhibit characteristics known to occur with acute, fatal stress in

cetaceans, including, to a limited experience, with Stenella. There is no known occurrence of chronic fatal stress in cetaceans.

3. Pathology associated with tissues collected from dolphins that have been killed through net entanglement are fully compatible with expected agonal changes at death.

There is no doubt that the animals chased and possibly encircled do undergo a stressor response. This is clearly apparent in the CHES data, and well described by St. Aubin (St. Aubin, 2002)) relative to that study and, as well, to others before it (ref). The analysis data set representing stress assessment from the CHES project revealed metabolite concentrations, e.g., cortisol, generally somewhat over that seen in similar situations with Tursiops. However, no conclusion can be drawn from this as to impact on morbidity or risk of mortality in these animals. We simply do not have a direct effect relationship between stress metabolite concentrations and risk of death. We do, on occasion, see the “adrenal firestorm” death spoken of by Cowan (Cowan and Curry, 2002)) in examining necropsy specimens from animals that died in association with net entrapment, in all cetacean species, referred to clinically as an acute shock reaction. These are experienced by health care workers to varying degrees (more prevalent in pelagic species), but in known and predictable situations, e.g., removal from water and under physical restraint. Such occurrences are very acute in onset, result in apnea (failure to breath), and are usually fatal, leading quickly into the agonal event, e.g., extreme and uncontrolled muscular spasms, extreme elevation of heart rate and irregularity in heart contractility prior to loss of cardiac function. No doubt, such an event occurs in many, if not all, of the animals killed through entrapment in the net. However, this phenomena does not carry over past the stressor event. Therefore, if an animal is saved from net entrapment, and survives that immediate event, it would not be expected to be in risk of ‘shock’ from that point further. There is no evidence in the CHES study that there is continued risk of death due to stress after release from the net, and there is no evidence anecdotally from other species that such would be the case.

B. Capture myopathy- As a cause of indirect mortality in, or associated with, the encirclement of the dolphins within the purse seine net, my opinion is that capture myopathy, in-of-itself, does not represent a primary factor.

1. This disease of skeletal muscle rupture and necrosis due to acute and strenuous physical exertion, has not been observed as a re-occurring clinical entity in cetaceans (as compared to ungulates) of any species.
2. Muscle degeneration, as reported by Cowen (Cowan and Curry, 2002) in heart muscle from acute degeneration can be attributable to the agonal processes noted above.
3. Muscle degeneration (non-fatal)) , as reported by Cowen (Cowan and Walker, 1979) in skeletal muscle from past incident(s) of tissue trauma are of unknown etiology and cannot be directly associated with net encirclement.

Muscle degeneration, known well by clinicians dealing with ungulates, simply is not a clinical problem in cetaceans of any species. Cetaceans are athletic animals that are capable of, and used to, aerobic exercise. It is very unlikely that dolphins, involved in the purse seine operations, would exhibit an entirely different response physiologically to a particular stressor that they (collectively referring to all cetacean species) have not exhibited in other stressful situations.

C. Disorientation following an event of particularly high stress and physical exertion, leading to vulnerability to predation- In my opinion, mortalities are likely occurring as a result of predation in this manner.

1. No way to rule this out.
2. Perhaps likely with certain individuals at the extreme end of relative experiences in the pre-capture chase and/or the net encirclement, e.g., animals 'saved' from net entanglement by diligent fishermen and co-workers.
3. No way of knowing how long such animals might be emitting disorientation signals to sharks (primary predators), or how many dolphins might be in such a vulnerable position.
4. It is known that, through observer reports, predators have taken individual dolphins at the back down exit. No information is available about what the stimulus for such predation is.

There is a high probability that a number of dolphins are taken from the population through this indirect means. There is no way of knowing what this number is. It is unlikely that it amounts to as many as 2 animals per set overall (or 11,000 animals for each of the two species annually).

D. Aborted fetuses resulting from the stress and exertion occurring in, or associated with, the encirclement of the purse seine net- In my opinion, mortalities are likely occurring as a result of this problem.

1. We know from experience with other cetaceans that fetuses can be aborted in association with maternal disease, poor chronic nutrition, stressor events such as capture, transportation and re-location.
2. The operations associated with the encirclement of the purse seine net certainly would qualify as such a stressor event.
3. When abortions from such stressor events occurs, they generally do so within days or weeks following the event.

There is a high probability that a number of dolphins are taken from the population through this indirect means. We have no way of knowing how many. It should be said here that dolphins of all species incur a relatively high mortality rate of fetuses, neonates, and calves from natural causes. Dolphins are long-lived, and such mortality is a selective process that assures a stable population both in numbers and in overall

vitality. Under normal circumstances, loss of a fetus or neonate is followed quickly (two to three months) with a successive new pregnancy.

- E. Reduced fecundity due to chronic physiologic impairment- We have no way of assessing this possible cause of indirect effect on population growth.

We have noted that certain groups of Tursiops females exhibit poor reproductive productivity when faced with senility, relative poor chronic health, nutrition, social balance and/or physical spatial compatibility. We assume that none of these factors are relevant to a population of pelagic dolphins that must remain vital in order to survive. It is possible that an extreme amount of regular stressor events could result in a similar affect on reproductive productivity. We have no way of assessing if such is occurring with any of the animal groups in focus. Clearly, some groups of these animals are set on more than others. It would be interesting to consider the fecundity of those females that are at the extreme of the affected curve. In any case, it is unlikely that this cause would represent a significant loss of reproductive productivity to the population as a whole.

- F. Cow/calf separation- As a cause of indirect mortality in, or associated with, the encirclement of dolphins in the purse seine net, my opinion is that this one cause could represent a significant source of mortality loss to the population.

1. Dolphins, of all species, have strong maternal/calf bonds, such that mothers maintain surveillance and protection of calves amidst extremes of stressor events.
2. Calves have a dependency on their mothers for protection, nutrition, social stability, and stressor mediation up to the time of weaning.
3. Weaning is defined, for the benefit of this discussion, as passing of calf dependency from mom for the essential life functions as noted in #2 above.
4. The viability of cetacean calves is known to be vulnerable to external stressors. This vulnerability is directly related to the age of the calf-- neonates are most vulnerable, older calves are less.
5. Based on experience with Tursiops and Commerson's calves, we can predict that Stenella calves are fully capable of independent survival at approximately age 9 months.
6. We don't know if mothers, with their calves, separate themselves from a group of dolphins being chased, and if so, when.
7. We don't know if mothers, from a group of dolphins being chased, at some point abandon their calves voluntarily or not. If they do, we don't know when or what the likelihood is that they will be able to re-establish contact.
8. We don't know, in the event of a cow/calf separation, what are the criteria that determine if contact can and will be re-established, e.g., age of calf, acoustic range of separation, ability of calf to avoid predation in the meantime, etc..

9. Due to the known vulnerability of newborn cetacean neonates, it is highly probably that in an extended chase situation, either the mom/calf pair would separate from the chase early, or that such a calf would separate from its mother and become extremely vulnerable to predation.
10. There can be little doubt of the likelihood that over that past 40 years of purse seine operations, predators have become conditioned to the sounds emitted by the operation and are attracted to the source for an easy meal. As such, one can expect that predators are readily present to take advantage of any abandoned calves (or disoriented adults) as noted above.

There is a high probability that some calves will be lost as stated above. As noted, dolphin calves are highly vulnerable to a wide variety of stressor events. They simply cannot survive an extended and persistent chase (of one hour or more). If their mothers don't separate from the chased group, I can see a high likelihood that separation will occur in many cases. In this case, the younger the calf, the higher the probability of separation and loss to predation. To further lend concern in this possible indirect effect, is the fact that chasing and encircling large groups of dolphins (500 or more) is the norm. As such, there is an increased probability of impact with large numbers of calves thus put at risk at any give set operation. To address this critical question, better and more aerial photographic assessments of dolphin group age composition must be done. If there is a loss of calves sufficient to account for the majority of the 11,000 individual losses to each of the assessed populations, there should be a notable absence of this age class of individuals as compared to non-fishery associated populations. Finally, if calves are lost during the chase portion of the purse seine operation, this would have to have been occurring throughout the history of the fishery, as methodologies, with respect to the chase, have not changed significantly over time. As such, it is troublesome to me that there are no accounts of such being observed, or of calf predation away from the encirclement or of predator feeding activity associated with separated calves, e.g., bird activity, splashing, blood, etc. After 40 years of purse seine operations, it seems that either calf loss is not occurring at the rate expressed as a concern here, or these sorts of occurrences are not being reported.

III. Conclusions

In trying to forward a meaningful assessment of possible indirect effects on populations of northeastern offshore spotted dolphins and eastern spinner dolphins resulting from purse seine on tuna fishing operations, it is frustrating that so little information is available in either directly obtained data or in field observer operations. Clearly, there needs to be a better cooperation between the regulatory bodies and the researchers from the various agencies that have oversight in this process.

As to the question of whether or not there are indirect, or un-reported, events that are having an impact on the recovery of the two species of interest here, we can subjectively predict that among the potential causative factors noted above, there are plenty of opportunities to account for a relatively small loss per net set, taken as a multiple of the

total number of sets made on these groups annually. The problem is that, with the absence of succinct data or clear and consistent observations, we have no way of separating fact from conjecture based on experiences with other species in other more or less comparable stressor situations. We can but forward our best guess at what might be happening.

Clearly, we need more information in data generated from direct sampling, as well as from population modeling analyses. There are important implications to the decisions being made here. The process requires more than speculation.

IV. References

1. Cowan, D.F., and B.E. Curry. 2002. Histopathological assessment of dolphins necropsied aboard vessels in the eastern tropical Pacific tuna fishery. Southwest Fisheries Center Admin. Rep.
2. Cowan, D.F., and W.A. Walker. 1979. Disease factors in *Stenella attenuata* and *Stenella longirostris* taken in the eastern tropical Pacific

yellowfin tuna purse seine fishery. Southwest Fisheries Center Admin. Rep. LJ-79-32C

3. St. Aubin, D.J. 2002. Hematological and serum chemical constituents in pantropical spotted dolphins (*Stenella attenuata*) following chase and encirclement. Southwest Fisheries Center Admin. Rep.